

In view of the following remarks and authorities and the accompanying terminal disclaimer, Applicants respectfully submit that the rejection of claims 1-28 is improper and that all of the claims are in condition for allowance.

**I. The Claims are not Anticipated by the Cited Prior Art References.**

A claim is anticipated only if each and every element as set forth in the claim is found in a single prior art reference. Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987). “The identical invention must be shown in as complete detail as is contained in the . . . claim” and all of the claimed elements must be “arranged as in the claim.” Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236, 9 U.S.P.Q.2d 1913, 1920 (Fed. Cir. 1989). The prior art references relied upon by the Examiner fail to satisfy these requirements.

**A. Claims 1-7 are not Anticipated by Lifshits.**

Claim 1 provides for a radiant wall furnace having a burner configuration utilizing rows or columns or both of multiple radiant wall burners and comprising an array of secondary fuel gas nozzles located separate and remote from the radiant wall burners, and means for introducing secondary fuel gas into the secondary fuel gas nozzles, whereby the secondary fuel gas mixes with flue gases in the furnace and combusts with excess air, lowers the temperature of the burning fuel gas and reduces the formation of NO<sub>x</sub>.

Lifshits fails to disclose all of the limitations of claim 1. For example, Lifshits discloses a burner 10 in which secondary fuel gas ports are integrated into a burner plate 12 which is mounted into the furnace. (See FIGS. 1-2 and Col. 2, lines 62-64.) The secondary fuel gas ports in Lifshits are “located around the periphery of the air ports array.” (See Col. 3, lines 17-21.) “The pattern of secondary fuel injection in general is such that the secondary fuel jets penetrate in between the jets of air and primary fuel, or products of its combustion.” (Col. 4, lines 16-19.) Consequently, the secondary fuel gas ports in Lifshits are neither “separate” nor “remote” from “an array of radiant wall burners.”

In addition, claim 1 provides that the “secondary fuel gas mixes with flue gases in the furnace and combusts with excess air.” Nothing in Lifshits suggests that the secondary fuel gas should or even could mix with furnace flue gases prior to mixing with the fuel gas-air mixture in the combustion zone. Instead, Lifshits teaches that the secondary fuel gas “at first entrains partially cooled products of combustion surrounding the flame and then mixes with the remaining combustion air and burns in a secondary combustion zone.” (See Col. 3, lines 46-49.)

Significantly, the primary purpose of the Lifshits burner is flame stability rather than reduced NOx emissions. In Lifshits, the burner plate necessarily includes additional small ports (located in between the air ports) through which anchor gas is injected into the furnace. (See Col. 3, lines 10-14.) Although providing greater flame stability, the addition of anchor gas would actually raise the level NOx emissions contrary to the underlying purpose of the instant invention.

Likewise, claims 2-7 are not anticipated by Lifshits because they depend from a patentable claim. Moreover, these claims each include one or more limitations not disclosed by the prior art relied upon by the Examiner. For example, Lifshits does not teach an array of secondary fuel gas nozzles arranged in at least one row adjacent to rows of radiant wall burners as in claims 2, 4, 5, 6, and 7. This reference merely discloses secondary fuel gas nozzles concentrically disposed around the periphery of a single burner plate. In short, Lifshits fails to teach all of the limitations of claims 1-7 arranged as in the claims, and the rejection of these claims should be withdrawn.

**B. Claims 15-21 are not Anticipated by Knight.**

Claim 15 provides for a method of burning fuel gas and air in a radiant wall furnace whereby flue gases of reduced NOx content are formed comprising the following steps:

- (a) providing a fuel lean mixture of fuel gas and air to individual radiant wall burners arranged in rows along a wall of the furnace;
- (b) causing the mixture of fuel gas and air to flow radially outward from each radiant wall burner across the wall of the furnace whereby the mixture contains excess air and is burned

at a relatively low temperature and flue gases having low NO<sub>x</sub> content are formed therefrom; and

(c) providing secondary fuel gas from secondary fuel gas nozzles located whereby the secondary fuel gas mixes with flue gases in the furnace and combusts with excess air from the radiant wall burners, lowers the temperature of the burning fuel gas and reduces the formation of NO<sub>x</sub>.

The Knight method is entirely different from the method of claim 15. The instant invention provides for a method of staged fuel burning. Knight, on the other hand, discloses a method of staged fuel mixing prior to injecting the mixture into the furnace. (See Col. 2, lines 31-33 and Col. 3, lines 6-10.) In fact, this reference teaches a method that is completely contradictory to the instant invention. For example, in Knight, the mixture of primary fuel gas and air is not caused to flow outward from each radiant wall burner across the wall of the furnace to be burned at a relatively low temperature as provided in step (b). Instead of burning the primary gas-air mixture, the burner in Knight utilizes aerodynamic mixing techniques to create a noncombustible primary gas-air mixture. (Col. 1, lines 48-53; Col. 2, lines 33-37.)

Further, Knight fails to teach the limitations recited in step (c) of claim 15. In Knight, the secondary fuel gas is mixed with a different substance in a different location to achieve a different purpose. According to Knight, the secondary fuel gas is not mixed with flue gases in the furnace and does not combust with excess air from the burners. Instead, the secondary fuel gas is added to the noncombustible primary fuel gas-air mixture inside a burner to form a combustible fuel-air mixture which “slows to a velocity that will support combustion.” (See Col. 1, lines 53-57; Col. 2, lines 60-65; col. 3, lines 24-20.) The exhaust gases are “removed from the combustion chamber by an induced draft fan through a flue. (See Col. 4, lines 9-10.)

Moreover, “lowering the temperature of the burning fuel gas and reducing the formation of NO<sub>x</sub>” in step (c) is not inherent in the disclosed flashback flame resistance purportedly achieved in Knight. The problem of flame flashback occurs internally within a single burner. Knight proposes reducing the incidence of flashback by employing aerodynamic techniques to

create a noncombustible primary fuel gas mixture. The noncombustible mixture in Knight is then accelerated to a velocity higher than the flame speed of a combustible mixture of the primary fuel and air. "The high flame speed flow creates an aerodynamic barrier to flame propagation that prevents flash back." (Col. 2, lines 31-59.) The reduction of flashback inside the burner by increasing the velocity of a noncombustible primary fuel gas-air mixture is completely unrelated to the reduction of temperatures of burning secondary fuel gas outside the burner.

Knight does not anticipate claims 15-21, because it fails to teach all of the limitations of claim 15 arranged as in the claim. This reference also fails to teach the limitations of each of the dependent claims 16-21. Knight teaches a method in which a secondary fuel nozzle is located inside a burner, rather than configured in rows adjacent to rows of radiant wall burners. Nothing in Knight suggests that the secondary fuel gas nozzles should be located in rows adjacent to the rows of radiant wall burners. As a result, the rejection of claims 15-21 should be withdrawn.

## **II. The Claims are not Obvious over the Prior Art Relied Upon by the Examiner.**

As an initial consideration, dependent claims are non-obvious under 35 U.S.C. § 103 if claims from which they depend are non-obvious. See In re Fine, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988). As discussed more fully above, independent claims 1 and 15 are neither anticipated by nor obvious over the prior art relied upon by the Examiner. Thus, claims 2-14 and 16-28 are non-obvious because they depend from non-obvious claims. Furthermore, each of the dependent claims each contain one or more limitations not suggested or implied by the combination of prior art references.

In order to establish a prima facie case of obviousness by combining multiple prior art references, "[t]he Examiner must show reasons that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed." In re Rouffet, 149 F.3d 1350, 1357, 47 U.S.P.Q.2d 1453 (Fed. Cir. 1998). The prior art must contain some suggestion or incentive that would have motivated an artisan to modify the reference. See

In re Fine, 837 F.2d 1071, 1074, 5 U.S.P.Q.2d 1596, 1598 (Fed. Cir. 1988). In addition, the prior art must suggest the desirability and obviousness of making the modification without the slightest recourse to the teachings in the application. See Amgen, Inc. v. Chugai Pharmaceutical Co., Ltd., 927 F.2d 1200, 18 U.S.P.Q.2d 1016 (Fed. Cir. 1991). Furthermore, the reference must teach or suggest all of the limitations of the claims. Significantly, there is no incentive to combine the prior art references in the manner set forth by the Examiner. Of course, even if such combinations were supportable, the combination of references relied upon by the Examiner still would not render the claimed invention obvious. Accordingly, a prima facie case of obviousness has not been established.

**A. Claims 8-11 are not obvious over Lifshits in view of Wang and claims 22-25 are not obvious over Knight in view of Wang.**

Nothing in either Lifshits or Wang suggests or implies a furnace with secondary fuel gas nozzles that are separate and remote from an array of radiant wall burners whereby secondary fuel gas mixes with flue gases in the furnace. Similarly, neither Knight nor Wang discloses providing secondary fuel gas from secondary nozzles whereby the secondary fuel gas mixes with furnace flue gases and combusts with excess air from the radiant wall burners. In addition, these references (alone or in combination) do not suggest the limitations of claims 8-11 and 22-25.

For example, these references do not suggest that a secondary fuel gas nozzle should have a tip having at least one fuel delivery opening therein to eject fuel gas toward or away from the wall of the furnace at an angle relative to the axis of the secondary fuel gas nozzle. Wang merely discloses dividing the total heat release from a burner into flamelets that create a fan shape. This reference has nothing to do with ejecting a secondary fuel gas from a nozzle that is separate and remote from the burners at an angle relative to the furnace wall. In fact, Wang is limited to a furnace in which each burner subunit has a single fuel supply. (See Paragraphs 6 and 18.) Consequently, there is nothing in any of these references alone or in combination that would lead someone skilled in the art to make the necessary modifications to arrive at the

claimed inventions of claims 8-11 and claims 22-25. As a result, a prima facie case of obviousness has not been established and the rejection of these claims should be withdrawn.

**B. Claims 12-14 are not obvious over Lifshits in view of Johnson and claims 26-28 are not obvious over Knight in view of Johnson.**

Nothing in Lifshits and Johnson, alone or in combination, suggests a remote staged furnace having an array of secondary gas nozzles located separate and remote from radiant wall burners. Likewise, Knight and Johnson do not suggest a method of providing secondary fuel gas from secondary nozzles located whereby the secondary fuel gas mixes with furnace flue gases and combusts with excess air from radiant wall burners. Johnson does not disclose any radiant wall burners attached to the furnace wall but utilizes a free standing floor burner. Additionally, the secondary fuel gas nozzles in Johnson are not remote from the burner and are not “located whereby the secondary fuel gas mixes with furnace flue gases.” Instead, the secondary fuel gas nozzles form a concentric array around the centerline of the outlet of the floor burner. (Col. 3, lines 15-17.) In Johnson, NO<sub>x</sub> production is reduced by using high pressure inert gas jets located within each secondary gas nozzle to modify the trajectory of the secondary fuel. Without the high pressure inert gas jets, the burner in Johnson would be a typical high-NO<sub>x</sub> burner. As a result, claims 1 and 15 are non-obvious over the prior art relied upon by the Examiner.

Moreover, these patents do not suggest or imply the limitations of claims 12-14 and 26-28. Nothing in any of the prior art references suggests a furnace with floor burners adjacent to a furnace wall having radiant wall burners attached thereto as in claims 13 and 27. Similarly, none of these references imply that the secondary fuel gas nozzles should each have tips having multiple fuel delivery openings positioned to eject fuel gas toward or away from the wall in multiple directions as in claims 14 and 28. Because a prima facie case of obviousness has not been established, the rejection of claims 12-14 and 26-28 should be withdrawn.

**III. A Terminal Disclaimer Has Been Filed to Overcome the Provisional Rejection Based on Obviousness-Type Double Patenting.**

In the Office Action, the Examiner provisionally rejected all of the pending claims under the judicially created doctrine of non-statutory double patenting over the claims in co-pending Application No. 10/807,927. In order to overcome this rejection, a terminal disclaimer in compliance with 37 C.F.R. § 1.321(c) is submitted herewith. As indicated in the disclaimer, Application No. 10/807,927 is commonly owned with the present application. In view of the terminal disclaimer, Applicants request that the Examiner withdraw the obviousness-type double patenting rejection.

**CONCLUSION**

For the foregoing reasons, the rejections under § 102, § 103 and the doctrine of double patenting should be withdrawn. The references relied upon by the Examiner do not anticipate claims 1-7 and 15-21. Nor do the cited references teach, suggest or imply that the prior art should be modified to comprise the invention set forth in claims 8-14 and 22-28. A terminal disclaimer is submitted to overcome the obviousness-type double patenting rejection. Accordingly, claims 1-28 are in condition for allowance and such action is respectfully requested.

This is intended to be a complete response to the Office Action mailed on February 16, 2005.

I hereby certify that this correspondence is being deposited in the United States Postal Service as first class mail in an envelope addressed to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.



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